

# Dentofacial Relapse in Class II Patients Treated with Functional Appliances

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## Abstract

**Aim:** Considering the importance of stability on the orthodontic treatment outcomes, the instability may cause dentoskeletal and soft tissue changes in patients after the treatment. The aim of this study was to evaluate dentoskeletal and facial soft tissue relapse in class II patients whom have been treated with functional appliances.

**Materials & Methods:** 23 patients with Class II Division 1 malocclusion who had received treatment with Farmand functional appliance and had at least two years of post treatment follow up, were evaluated using cephalometric analysis for dentoskeletal and soft tissue changes. The lateral cephalometric radiographs of the patients immediately after the treatment (T1) and two years follow up (T2) were traced and statistical analysis was performed to obtain the amount of occurred relapse between T1 and T2.

**Results:** The mean decrease of ANB angle between T1 and T2 was 0.73 °, which was not statistically significant. Overall, the mean changes of skeletal and dental variables (FMA, GOGN-SN, U1 to SN, U1 to FH and IMPA) in T1 and T2 were not statistically significant. For the soft tissue variables, the mean increase of the nasolabial and mentolabial angle in T1 and T2 were not significant. The mean changes of Z and H angles in T1 and T2 were 0.53° and 0.63 °, which were not statistically significant.

**Conclusion:** Dentoskeletal and soft tissue facial changes that occurred during treatment with Farmand functional appliance remained stable at least 2 years after treatment.

**Key words:** Functional appliance, class II division 1, Malocclusion, relapse

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## Introduction

Growth modification is an accepted treatment especially for correcting mild to moderate anteroposterior skeletal discrepancies during growth. Due to new experiences about growth and development of the face, functional appliances can cause significant growth changes. These appliances are mostly being used for treatment of Angle Class II malocclusion with mandibular deficiency(1,2,3). The prevalence of Class II malocclusions according to Angle's classification in American white, American black and Danish children is 18%, 12% and 24% respectively (4,5,6). In Iran, Angle Class II malocclusions are the most commonly treated cases at the medical centers and its prevalence is 20%(7,3). Functional appliances result in skeletal changes by increasing the length of the mandibular body and lower third of the anterior facial height (8,9,10,11). Similarly, these appliances have some effects on dentoalveolar segment such as the retro inclination of the upper incisors and proclination of the lower incisors (1,12,13,14,15,16), which can influence the soft tissue profile (2,17,18,19,20,21,22). The Farmand appliance has been designed by Dr Mahdi Farmand in 1972 and registered in Loyola University and is used by most Iranian general dentists and orthodontists for treatment of patients with Class II malocclusion with mandibular deficiency. This appliance is consisted of upper and lower flexible arches, a tongue bow and four stops at the mesial aspect of the first molars. Due to our clinical experience, this appliance is well tolerated by the patient(1,2). Figure 1 depicts a Farmand functional appliance.



**Figure 1.** Farmand functional appliance

Functional appliances are being used with the intention of improvement of dentoskeletal and soft tissue profile, but these alterations are good only if these changes remain stable over time.

There are only few studies about the stability of functional treatment. Janson studied the cephalograms of 23 patients, 5.75 years after treatment with Headgear-Activator (23). He reported the dentoalveolar and skeletal changes resulting from treatment were stable, but a significant relapse in overbite has been seen.

Berger studied 15 patients out of 30, who had been treated with Frankel functional appliance and 15 had been treated with Herbst functional appliance (24). Their follow up period was about 35.8 months. They reported that the ANB angle remained stable and the GoGn-SN angle did not show a significant change.

In a more recent study, Lerstol evaluated the long-term stability of activator headgear combination in 26 class II patients (25). The patients were visited 12-15 years after the treatment. They concluded that combined activator headgear treatment improved the skeletal and dental conditions and showed long-term stability.

Stability is considered as the fundament of orthodontic treatment success. Since there have not been much studies about the stability after the treatment with Farmand functional appliance, we decided to evaluate dentoskeletal and soft tissue facial relapse in class II patients whom have been treated with Farmand functional appliances.

## Material & Methods

The present descriptive analytic study was performed in Yazd dental school. Pre and post treatment photographs of one patient are presented in figures 2, 3 , 4. Out Of the 35 patients with skeletal class II Division 1 malocclusion who had been treated with Farmand functional appliance type II, we could only reach 23 patients for follow up. Thus, the cephalograms of these patients taken immediately after the treatment (T1) and at least 2 years follow up (T2) were studied.

Our final samples included 15 girls and 8 boys aged between 8 and 13 years (mean age 10.6 years) before the treatment. Our follow up program lasted for at least 2 years (mean: 4 years, range of 2-8 years).

All patients were selected based on the following criteria:

- Class II div 1 malocclusion with mandibular deficiency and a convex profile treated with Farmand functional appliance
- responded well to the functional appliance therapy



**Figure 2.** Pretreatment photographs of frontal, profile and intra oral view of a patient.

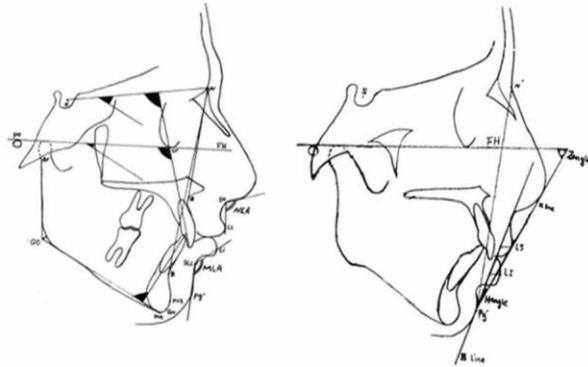


**Figure 3.** Post treatment photographs of frontal, profile and intra oral view of the patient.

- In the follow up period, at least 2 years since completion of treatment with Farmand appliance
- Clear anatomic landmarks on the lateral cephalometric radiographs



**Figure 4.** Lateral cephalometric radiographs of another patient. A: Before treatment B: with completion of active treatment C: 41 months after active treatment.



**Figure 5.** linear and angular measurements of hard and soft tissues.

The patients who received fixed orthodontic treatment after functional appliance therapy were excluded from the study.

Informed consent was taken from the patients to take cephalometric radiographs in follow up program. One researcher with one-week interval traced each cephalometric radiograph two times. If there was a difference in the measurement between two tracings of one patient, the average was being used. The digital radiographs were taken in Sajjad Radiology Center (Planmeca, EC model, Finland, 2002) under the standard conditions (Teeth in centric occlusion, the lips in their relaxed position and the patient situated in the natural head position).

The cephalograms were traced using certain linear and angular measurements of soft tissue profile and dentoskeletal regions (26,27,28,29,30).

The linear and angular measurements used for hard and soft tissue analysis have been presented in table 2 and Fig 5.

Statistical analysis was performed using one sample t test to compare the difference of the mean values in T1

and T2 in order to obtain the amount of relapse occurred after the treatment.

**Table 1.** Changes in dentoskeletal and facial soft tissue variables at T1 and T2 after treatment with Farmand functional appliance

| Variables<br>(unit of measurement) | T1 |        |       | T2 |        |       | Changes |             | P value |
|------------------------------------|----|--------|-------|----|--------|-------|---------|-------------|---------|
|                                    | N  | Mean   | SD    | N  | Mean   | SD    | Mean    | CI 95%      |         |
| ANB angle<br>(degree)              | 35 | 5.17   | 1.69  | 23 | 4.43   | 2.61  | -0.72*  | -1.86 0.39  | 0.190   |
| FMA angle<br>(degree)              | 35 | 27.01  | 5.88  | 23 | 25.91  | 6.23  | -1.097  | -3.79 1.60  | 0.408   |
| GOGN-SN angle (degree)             | 35 | 34.48  | 5.5   | 23 | 32.98  | 6.78  | -1.502  | -4.43 1.43  | 0.299   |
| Upper 1 to FH<br>(degree)          | 35 | 110.30 | 6.10  | 23 | 104.28 | 15.42 | -6.02   | -12.70 0.64 | 0.074   |
| Upper 1 to SN<br>(degree)          | 35 | 103.08 | 7.28  | 23 | 99.13  | 11.90 | -3.95   | -9.10 1.20  | 0.126   |
| IMPA angle<br>(degree)             | 35 | 103.54 | 8.85  | 23 | 108.70 | 15.08 | 5.16    | -1.37 11.68 | 0.115   |
| Nasolabial angle<br>(degree)       | 35 | 111.17 | 10.06 | 23 | 109    | 10.53 | -2.17   | -6.72 2.38  | 0.334   |
| Mentolabial angle<br>(degree)      | 35 | 128.26 | 13.57 | 23 | 131.91 | 12.87 | 3.65    | -1.91 9.22  | 0.187   |
| Z angle<br>(degree)                | 35 | 68.1   | 4.9   | 23 | 67.56  | 4.94  | -0.53   | -2.67 1.60  | 0.609   |
| H angle<br>(degree)                | 35 | 18.44  | 3.68  | 23 | 17.83  | 2.75  | -0.61   | -1.80 0.58  | 0.297   |
| LS-B line<br>(mm)                  | 35 | 4.78   | 1.87  | 23 | 4.20   | 1.67  | -0.58   | -1.31 0.14  | 0.584   |
| Li-B line<br>(mm)                  | 35 | 4.16   | 2.1   | 23 | 3.30   | 2.25  | -0.8    | -1.83 0.119 | 0.082   |

\* Decreased value is denoted by minus sign

N: number of the patients

**Table 2.** linear and angular measurements of hard and soft tissues.

| Measurements                  | Explantation  |
|-------------------------------|---|
| <b>H-Line</b>                 | From soft tissue Pogonion(Pog') to the prominent part of the upper lip(Ls) (27)   |
| <b>B-Line</b>                 | Subnasale(Sn) to Pog' (26)  |
| <b>Z-Line</b>                 | Pog' to the most anterior part of either upper or lower lip(LI), whichever is more protrusive(28)                         |
| <b>H-Angle</b>                | The angle formed by the intersection of soft tissue Nasion(N') to Pog' and Pog' to Ls(27)                                 |
| <b>Z-Angle</b>                | The angle formed by the intersection of Z-Line and Frankfort horizotal plane(FH) (28)                                     |
| <b>Nasolabial Aangle(NLA)</b> | The angle formed by two lines, a columella tangent and the upper lip tangent(29)  |
| <b>Mentolabial Angle(MLA)</b> | The angle is constructed by the intersection of a line from Pog' to inferior labial sulcus(ILS) and a line from ILS to LI |
| <b>FMA</b>                    | Frankfort- mandibular plane angle(30)   |
| <b>IMPA</b>                   | Incisor -mandibular plane angle(30)   |

## Results

*Skeletal and dental Changes:* As shown in table 1, the means for ANB angle was 5.17° at T1 and 4.43 ° at T2. The mean reduction of the ANB angle was 0.73°, which was not statistically significant.

There was not a significant difference for any of the skeletal variables used for determination of growth pattern (FMA, GO Gn-SN) between T1 and T2.

Also, there was not any significant statistical difference for dental variables such as U1 to FH angle, U1 to SN angle and IMPA between T1 and T2.

*Soft Tissue Variables:* As shown in table 1, there was not any significant difference between corresponding soft tissue variables in T1 and T2.

## Discussion

*Skeletal and dental Changes:* Previous studies have shown that functional appliances result in an increase in SNB angle and therefore improvement of maxillary – mandibular relationship and a decrease in ANB angle (11,16,23,24,25,31,32).

In this study the change in the ANB angle, which depicts the skeletal relation of the maxilla and mandible, was not significant in follow up. Janson (23) and Lerstol (25) reported the long-term stability of anteroposterior relation of the maxilla and the mandible in Class II div 1 patients treated with Headgear-Activator.

Our findings about the stability of anteroposterior relation of the maxilla and the mandible after the treatment is similar to those of other studies that evaluated long-term stability after functional appliance therapy (23,24,25).

FMA and GoGn-SN angles, which are used to determine the changes in facial growth pattern, did not show any significant changes two years after completion of treatment which is similar to the results of the studies by Janson (23) and Berger (24) .

Farmand appliance type II causes retro inclination of the upper incisors and proclination of the lower incisors and thus plays an important role in correction of the increased over-jet in patients with Class II div 1 malocclusion (16). In our study the treatment outcomes that were obtained during treatment, remained stable in follow up.

In this study, we evaluated the dental changes in relation with SN and FH plane. We concluded that anteroposterior dentoalveolar changes remain stable over a long period of time, which is being upheld by the results of other studies (23,24,25).

We also concluded that, while treating with a Farmand functional appliance more skeletal changes than dental are being achieved. No other study has stated this.

*Facial Soft Tissue Profile Changes:* In previous studies (2,18,22), it has been reported that different functional appliances result in significant increase in the NLA angle to nearly normal levels, a decrease in mentolabial fold, and an impact on beauty of the lips, chin and facial profile. Our study did not address the changes that may occur during functional appliance therapy, but our soft tissue treatment outcomes remain stable at least two years after the treatment.

In one study about facial soft tissue changes in Class II div 1 patients treated with Farmand appliance, it was reported that the lip strain of the patients was improved. Therefore, treatment did not result in any change in nasolabial angle (2). In our study, the obtained

nasolabial angle during treatment did not show any significant change at least two years after completion of treatment.

According to previous studies, functional appliances result in normal placement of the upper lip in relation to B-line (2). The lower lip position in relation to this line does not show any significant change (2). In our study, the position of lips was good after the treatment and it remained stable in follow up.

## Conclusion

The treatment outcomes of functional appliance therapy with Farmand remain stable for at least 2 years after treatment.

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